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“He was a friend of the greatest geniuses of his time – indeed, he was one of them” – Ludwig Hopf (1884-1939)

This article concentrates on the life and work of Ludwig Hopf, including the effects the Nazi regime had on him and his time in Dublin where he arrived in July 1939 as a “Refugee of distinction”, some five months before his death, in order to teach at Trinity College Dublin. Born in 1884 in Nuremberg he studied Mathematics and Physics at Berlin, Munich and Zurich. For his PhD he was supervised by Arnold Sommerfeld in Munich. Later he worked in Zurich and Prague as Albert Einstein’s assistant before moving to Aachen where in 1923 he became professor for mathematics at the Technical University. Suspended in 1933 and pensioned off in 1934 he tried to support the emigration of his four sons and searched for a long time in vain to find a new academic home for himself before he could emigrate in spring 1939 to England where the invitation from Ireland reached him.

In January 2014 an article appeared in the *Irish Times* recalling that, about seventy-four years earlier, a fifty-five year old mathematics professor from Germany who had found refuge in Ireland died in Dublin, only a few months after he had come there. The writer of the *Irish Times* article, journalist Frank McNally, had already elaborated on the Irish-Kenyan link that had brought Hopf’s story to his attention in three previous articles in his column ‘An Irishman’s Diary’.¹ This link was through Fr. Willie Walshe, an Irish priest who came to Kenya in the early 1970s to do missionary work, based in Kitale. The residents there included a German expatriate named Arnold Hopf – Ludwig Hopf’s third son. A magistrate in the old colonial service, Arnold Hopf had settled in Kenya and had married a local Catholic whose children became part of Walshe’s congregation. When Arnold Hopf died in 1992, Willie Walshe was asked to conduct the funeral service. In the following years he became fascinated to know that Arnold’s father Ludwig was buried in Dublin and he wondered where. Willie Walshe’s sister Kay McNamara, closer to the locality as she works in Dublin, took up the challenge and searched for Ludwig Hopf’s grave, eventually finding it in Mount Jerome Cemetery, Harold’s Cross, Dublin, originally a Protestant graveyard from the first half of the

19th century but opened up to other religions from the 1920s. Due to the endeavours of Willie Walshe and Kay McNamara as well as John Halligan, the gravestone was repaired in 2013. At the small gathering described by Frank McNally in 2014, there were prayers over Hopf's grave by Willie Walshe in English and by Tomi Reichental, who survived the concentration camp Bergen-Belsen as a boy and came to Ireland in the 1960s, in Hebrew.

Apart from these remembrances, there has not been much awareness of Ludwig Hopf and specifically of his short time in Ireland. If he is mentioned in English-speaking publications it is mainly a brief reference to him as Albert Einstein's assistant, often recalling that he introduced Einstein to C.G. Jung.² He also plays a part in Michael Eckert's publications on Arnold Sommerfeld, specifically his recent biography, and on the developments in fluid dynamics.³ Hopf is briefly mentioned in publications about exiled scientists⁴ but there appears to be only one article dedicated to him. That article, in German, draws on files at his main work place, the Technical University in Aachen, and mainly concerns the developments leading to his suspension and subsequent early retirement under the Nazi regime.⁵ So who was Ludwig Hopf, what kind of background did he have, how was his relationship with the "greatest geniuses" (and who were they?) – and what can we establish regarding his own genius?

Hopf's background was an established Jewish family of hop traders in Nuremberg. Löb Hopf, his great-grandfather moved there from Upper Franconia in 1852, where he was among the first Jews to acquire citizenship.⁶ His son Stephan Hopf (1826-1893), Ludwig's grandfather, was appointed to high public office and became "respectably wealthy" as a hop wholesaler.⁷ Ludwig Hopf's mother Elise, neé Josephthal, was the daughter of Gustav Josephthal who presided over both the Nuremberg lawyers and Nuremberg's liberal Jewish community, the latter for four decades from 1869-1909, and whose family had been for generations in Franconia. Ludwig Hopf's father Hans (1854-1918) continued in the family tradition as a hop merchant and municipal counsellor. Ludwig, born in Nuremberg on 23 October 1884, was the eldest son. His two siblings Ernst and Betty remained connected with the hop business. Ernst Hopf joined forces in 1923 with two other Nuremberg hop traders, S. Krakenberger and the brothers Hesselberger (one of whom, Hermann, Betty had married, but who died the year before the merger), to form one of the leading worldwide hop companies.⁸ Ludwig, however, chose a different path and followed his scientific interests, though initially he had been attracted by philosophy and music.⁹ Science had developed an unprecedented allure at the beginning of the twentieth century. Following his *Abitur*, Hopf studied in Berlin and Paris

before coming to Munich in autumn 1906 where Arnold Sommerfeld had just begun to build one of the most important nurseries for theoretical physics in the world.

Sommerfeld's influence on theoretical physics in Germany and the importance of his Munich school can hardly be overstated; indeed, Michael Eckert argues that Arnold Sommerfeld was, together with Max Planck, Albert Einstein and Niels Bohr, one of the founding fathers of modern theoretical physics.¹⁰ Thanks to him Munich became the hub of theoretical physics following the establishment of a new institute with Arnold Sommerfeld as director. He supervised more PhD students who went on to receive Nobel prizes than any other academic previously or since. As one of the first professors in the world to regularly lecture on the new relativity and quantum theories he contributed considerably to the acceptance and development of the discipline and had an uncanny ability to spot and support talent among his students, for which he was admired by Albert Einstein and Max Born among others.¹¹ He also holds a less enviable record insofar as he was more often proposed for the Nobel Prize (81 times) than anyone else who was not awarded that Prize.¹²

For Ludwig Hopf, Sommerfeld became much more than just a PhD supervisor. He remained a lifelong trusted advisor and mentor, probably his most important anchor in the one community that Ludwig Hopf wanted to make his own – the academic one. While he continued with his musical and philosophical interests and was an always welcome guest in Munich's art scene,¹³ Hopf threw himself into the new developments in mathematics and physics with great enthusiasm. It quickly became obvious that he was a gifted teacher. When difficult material was discussed in seminars the other students demanded that Hopf should present it as he was able to do so clearly. Added to that was a sense of fun – at a social gathering at the end of the first semester of Arnold Sommerfeld's lecturing on relativity matters, Hopf and fellow Sommerfeld student Paul Peter Ewald¹⁴ (who, like Hopf, called one of his sons 'Arnold' in later years) presented an artistic version of the theory, with Hopf (of small stature and rather portly) as the stationary electron and Ewald (long and thin) as the moving electron – and the sketch was delivered, as Sommerfeld recalls in his obituary of Hopf, in excellent verses.¹⁵ Peter Debye, a talented Dutch physicist who had already been Sommerfeld's assistant in Aachen and moved with him to Munich, recalled that Ewald, Hopf and himself were prime movers in setting up the famous 'Sommerfeld seminars' – crucially excluding Sommerfeld so that "stupid" questions by younger students could be aired.¹⁶ Sommerfeld's method of integrating his students was to involve them in his latest research interest, set them current problems as tasks and at times employ them in experimental areas which were not his own forte. Debye remembers that Sommerfeld's fingers "were no good

that way”, i.e. lack of dexterity. Due to Sommerfeld’s interest in turbulence, that became Hopf’s PhD area.¹⁷ While his theoretical work was on ship waves, for his practical work,

Hopf was to investigate the turbulence transition in a flow with an open surface. Like flow through a pipe, a predominant laminar flow at a slow velocity should become unstable at some critical higher velocity and induce turbulence. To this end, Hopf constructed a rectangular trough, through which water flowed at varying angles of inclination. By adding sugar, he was able to adjust the viscosity of the water. The goal of the experiment was to determine the critical Reynolds number $R = Uhp/\mu$ (U = mean velocity of flow, h = width of the trough, ρ = density, μ = viscosity), at which the flow of water in the trough was no longer laminar but turbulent.¹⁸

However, the results were not very conclusive due to the surface tension also playing a role and making the complex process of the turbulence transition even less transparent.¹⁹

In his written assessment of the PhD, Sommerfeld found that Hopf was (like himself) “actually not experimentally skilful” but he praised his “great love for his subject and his unusual perseverance.”²⁰ Furthermore Hopf had clearly proven his academic ability, theoretically and practically.²¹ The theoretical part *Hydrodynamische Untersuchungen: Turbulenz bei einem Flusse. Über Schiffswellen* [Hydrodynamic studies: turbulence in a river. About ship waves] was published in 1910, a year after Hopf completed his dissertation under Sommerfeld in Munich; excerpts appeared in the prestigious journal *Annalen der Physik* [Annals of Physics].²²

Arnold Sommerfeld introduced Hopf to Albert Einstein at the 81st Congress of German Scientists and Physicians in Salzburg in September 1909. The event was an important one for Einstein too. It was his first invited presentation at a major academic event, an outward sign that he had arrived. His articles in the *Annalen der Physik* in 1905 had caused a stir among physicists. But, as Cornelius Lanczos maintains, Einstein was lucky that the greatness of his ideas was recognised by “the greatest minds of European physics particularly Planck, Laue and Sommerfeld” and later by others in Great Britain and France.²³ It was Salzburg where he first met many of them. At that stage he was in fact still officially working for the Patent Office in Bern, his resignation of July 1909 only coming into effect in mid-October 1909.²⁴ He had been able to resign as at last he had been offered a full-time academic post at Zurich Technical University. However, this was not a full professorship but an associate one (Außerordentliche Professur) which meant that in reality his income was initially the same as in the Patent Office²⁵ – with no proper budget to hire people.²⁶ Peter Debye indicated in a later

interview that it might well have been Hopf's independent means that allowed him to take up Einstein's offer to become his assistant.²⁷ Hopf's talent as a pianist and his being able to accompany Einstein's violin playing was an added bonus.²⁸ Einstein was only five years older than his new assistant. Their relationship seems to have been a very good one from the start. In a letter to his wife, Sommerfeld described a visit to his former student and Einstein in Zurich where the day started with playing Bach and where theoretical problems were later discussed in a quiet pub.²⁹ The image of Hopf in Carl Seelig's biography of Einstein, published in 1956 and built on his extensive correspondence with Einstein, draws Hopf as a "herzhafte Bayer" ["hearty Bavarian"],³⁰ whose happy outlook on life benefitted Einstein.³¹ Hopf also had a strong interest in psychoanalysis and it was Hopf who introduced Einstein to C.G. Jung (a meeting that proved to be of more interest to Jung than to Einstein). Sommerfeld even suggests that C.G. Jung was an additional reason, apart from Einstein, that attracted Hopf to Zurich and that he was a convinced follower of psychoanalysis:

"Although himself having a very healthy and balanced nature, he was intrigued also by the dark sides of the spiritual life and their elucidation by the psychoanalytic experiment" ["Obgleich selbst eine kerngesunde und ausgeglichene Natur, beschäftigten ihn doch auch die dunklen Seiten des Seelenlebens und ihre Erhellung durch das psychoanalytische Experiment"].³²

In a very short time the work with Albert Einstein resulted in two joint publications both in the influential journal *Annalen der Physik* in 1910.³³ For now Hopf had moved away from hydrodynamic turbulence and concentrated on a new field, radiation. His ongoing contact with Arnold Sommerfeld is also documented via publications; a joint research paper appeared in *Archiv der Mathematik und Physik* the following year.³⁴

Hopf went with Einstein to Prague in 1911 when he was called there, and seems to have helped considerably to settle Einstein there³⁵ but he then left for a position at the Technical University in Aachen, initially under Hans Reißner, then from 1913 onwards under Theodore von Kármán. Aachen offered not only an assistant position but also the option for a habilitation, the second doctorate required in German academia. Firstly though, he needed to catch up on elasticity theories in order not to let on to students how little a university physicist knows about these things, as he writes to Einstein soon after his move to Aachen.³⁶ He also asks for a photo: "And if you want to be especially nice, you will present me your image, which can then be enthroned next to Sommerfeld on my table" ["Und wenn Sie einmal besonders nett sein wollen, so verehren Sie mir Ihr Bild, das dann neben Sommerfeld auf meinem Tische thronen kann"].³⁷ While this request might well have included an element

of irony, the underlying admiration for both of his mentors is clear and his friendship with Sommerfeld and Einstein was to continue – as was his interest in turbulence.

But life was not only about work. Private interests came into the foreground and could be allowed now that a university career was feasible and a paid position had been obtained. In 1912 Ludwig Hopf got married in his hometown.³⁸ His wife Alice had a similarly privileged middle-class background. Her father Ferdinand Goldschmidt was a physician and had received the honorary title of ‘Geheimer Sanitätsrat’ in appreciation of his meritorious service in medical care in Nuremberg. He was also the author of a number of publications in the health sector.³⁹ The relationship between son-in-law and parents-in-law was so good that they eventually moved in next door in Aachen (and later followed them to England and travelled to Ireland with him, their daughter and granddaughter).

Another close friendship in Aachen developed with Otto Blumenthal, the longstanding editor of the *Mathematischen Annalen* [Mathematical Annals] and later of the *Jahresberichte der Deutschen Mathematiker-Vereinigung* [Annual Reports of the German Mathematical Society] and as such one of the three executive members of the ‘Deutsche Mathematiker-Vereinigung’, the German Mathematical Society. Otto Blumenthal (1876-1944) had been a friend of Arnold Sommerfeld since his student days in Göttingen where Sommerfeld was Felix Klein’s assistant. Blumenthal obtained a professorship in mathematics in Aachen in 1905, recommended by Sommerfeld who had been professor (in mechanics) there since 1900 (before leaving for Munich in 1906). Given the connection to Sommerfeld and their similar professional interests it is not surprising that a close relationship developed which later extended to Hopf’s parents-in-law.⁴⁰ While Hopf’s career was developing, his family life developed as well. After four sons, Hans (1913), Peter (1915), Arnold (1916) and Dietrich (1918), Ludwig and Alice became parents of a girl, Liselore (1925).

For his habilitation, which he handed in in 1914, Hopf returned to hydrodynamic questions of turbulence.⁴¹ It led to another publication in the *Annalen der Physik* the same year.⁴²

However, following the outbreak of the First World War, Hopf became increasingly immersed in aerodynamic research. After first serving in the infantry he was then transferred to a position driving lorries before being assigned in autumn 1916 to the aviation troop at Berlin-Adlershof where he was appointed as the engineer of the aviation troop in 1918. He engaged in a variety of aeronautical tasks including test flights which half a dozen years later became the basis for one of his major publications, *Aerodynamik* [Aerodynamics] – a 466 page long handbook, written together with Richard Fuchs, that brought together the available knowledge on aerodynamics at the time and remained the standard work for decades.⁴³ Two

key figures in aerodynamics and hydrodynamics of the time were well known to Hopf – Theodore von Kármán, his own director in Aachen, and Ludwig Prandtl, von Kármán's former supervisor. Between both a certain rivalry existed.⁴⁴ Hopf worked in close contact with Kármán. Hopf's own efforts were rewarded when in 1923 he was appointed professor of mathematics and mechanics. From the beginning he had become one of the most popular lecturers in Aachen.⁴⁵ His administrative burden increased. During 1925-1926 he served as dean in the faculty of science. He continued though with work in several areas and built up his publications list.⁴⁶ His strength of being able to explain difficult theoretical problems led him to become an author in the popular series 'Understandable Science' [Verständliche Wissenschaft] where in 1931 he published *Die Relativitätstheorie* [Relativity Theory].⁴⁷ Two years later his introduction to the differential equations of physics appeared in the esteemed publishing house Walter de Gruyter.⁴⁸ From 1930 onwards he replaced von Kármán as director of the Aachen Institute for Aerodynamics during Kármán's semesters in California and Hopf was also in charge of the *Außeninstitut* (the External Institute, representing humanities and social sciences at the RWTH Aachen) for two years. An active researcher, a proven administrator, an esteemed colleague and friend, a popular teacher and last but not least surrounded by a happy home life – it seemed Ludwig Hopf had found his place.

1933 – A shattered community, forlorn hopes

The political upheaval in Germany and the new Nazi rulers had an immediate effect on Ludwig Hopf's successful and happy life in Aachen. The "Law for a Restoration of a Professional Civil Service" ["Gesetz zur Wiederherstellung des Berufsbeamtentums"], passed on 7 April 1933 and intended to expel anyone of 'non-Aryan descent' as well as anyone who could be seen as a political opponent to the regime, led to his suspension.

In Aachen, 11 of the 123 professors were affected.⁴⁹ In general science the three professors were von Kármán, Hopf and Otto Blumenthal, who also came from a Jewish family, though he had converted to Protestantism when eighteen years old. Von Kármán was not much affected thanks to his position in Pasadena. For Hopf and Blumenthal two of the exemptions introduced due to pressure from German president Paul von Hindenburg (namely anyone who had fought in WWI and anyone who had been a civil servant since the beginning of World War I in 1914) should have been available.⁵⁰ But the immediate threat concerned spurious accusations of communist activities. In Hopf's case this was based on his membership in the "Gesellschaft der Freunde des neuen Russlands" [Society of Friends of the

new Russia]. On 13 April 1933 Hopf responded to the accusations against him, stating that to the best of his knowledge he had never publicly exhibited Communist or Marxist opinions but that he had always seen himself as a good German, that he had never belonged to a political party and that he always advocated the positions of middle ground parties. Nevertheless, he, along with other ‘non-Aryan’ colleagues, was suspended on 29 April 1933. In order to defend himself he also asked for testimonials. And he got them, something that was not always the case. Otto Geßler (1875-1955), prominent politician of the Weimar Republic and former mayor of Nuremberg, testified that Hopf’s family had played an important part in the governing of Nuremberg for generations and his grandfather and father were esteemed administrators, that both his parents had devoted themselves entirely and with the greatest sacrifice to servicing the urban war economy. Geßler went on to state that the early death of Ludwig Hopf’s father was probably due to the fact that he was completely exhausted in this service.⁵¹ The second reference, by his former supervisor Oberstleutnant a.D. [former Lieutenant Colonel] Felix Wagenführ emphasises his important contribution during WWI and his improvements to airplanes while working in Berlin-Adlershof.⁵² Interestingly, another letter is retained in the archive of the Technical University in Aachen which is significant for its professional context and sadly fairly unusual in the time – a statement of support by the Faculty of Science, signed by the Dean, Carl Wieselsberger. It summarises Hopf’s academic progress in Aachen and goes on to praise his “extraordinary pedagogical ability to make even the most difficult questions understandable” [“außerordentliche pädagogische Veranlagung selbst die schwierigsten Fragen verständlich darzustellen”], adding that accordingly his teaching is of the “highest importance” [“von höchstem Wert”] for the university. His research in aerodynamics is singled out as especially suited to Aachen where this was a focus and that he would be almost impossible to replace. His leadership skills are mentioned with regards to his directorship of the Institute of Aerodynamics when replacing Theodore von Kármán. His volunteering to do additional teaching is mentioned, as is his skilful and objective representation of the external institute.⁵³ But more than all this praise it is the last sentence that shows how much Hopf was valued by his colleagues: “Everyone who knows Mr Hopf will treasure his noble, kind character” [“Jedermann, der Herrn Hopf kennt, wird seinen vornehmen, gütigen Character schätzen”]. In May 1933 Hopf thanked his old mentor and supervisor Arnold Sommerfeld for his letters and concern. Hopf displayed a somewhat ambivalent relationship regarding leaving Germany: “Going abroad would mean exile for me. I would only do this if forced, so that the children have a home again” [“Ins Ausland gehen, hiesse für mich doch ‘Verbannung’, und

ich würde dies nur gezwungen tun, damit die Kinder wieder eine Heimat finden”].⁵⁴ The growing feeling of alienation within his own country was exacerbated by the exclusion from his professional environment: “But the push from the only community to which one actually belongs into empty space hurts a lot” [“Aber dies Hinausgestossenwerden aus der einzigen Gemeinschaft, in die man hinein gehört, in den leeren Raum hinaus, ist sehr schmerzlich”].⁵⁵ Initially there were hopes of opportunities abroad. In the same letter he writes about a position in England – though there it seemed (almost ironically) that Jewish faith was a precondition – and to that, he adds, he did not belong anymore.⁵⁶ His “rational belief” that the Nazi laws would be mainly withdrawn within three months⁵⁷ was already shattered one month later, leading surprisingly to a “ruchloser Optimismus” [“ruthless optimism”] that he and everyone else in his position are only the first to go into the abyss.⁵⁸ At the same time, he now started to approach contacts about the possibility of emigration.⁵⁹

There was also the matter that Hopf’s research work, especially with regards to aerodynamics, might be of interest to the new regime. Hopf had continued his work, and was in fact just finishing an update of his and Fuchs’s groundbreaking study from 1922, *Aerodynamik*. His part of the now three-volume project, published again with Richard Fuchs (who was still working in Berlin-Adlershof) and Hopf’s Aachen colleague Friedrich Seewald, appeared in 1934 as volume I – *Mechanik des Flugzeugs* [Mechanics of an Aeroplane].⁶⁰ It was reviewed very favourably:

The book is recommended to anyone interested in airplane design who has a reading knowledge of German, as it contains a thorough and comprehensive study of the mechanics of the airplane, and combines in a single small volume a large amount of practical and theoretical information.⁶¹

– though arguably at 339 pages it was not such a small volume.

The discussions regarding Hopf continued behind the scenes. In contrast to Blumenthal and other “non-Aryan” colleagues he was not dismissed in late September 1933. The Ministry for Science, Art and Education requested the assessments of the Minister for Aviation and the Minister of Defence in his case.⁶² Further references were requested from academics at different universities and despite their generally very positive feedback, some were judged as negative, specifically Ludwig Prandtl’s comparison between von Kármán and Hopf.⁶³ Hopf was officially dismissed on January 22, 1934 because of his “non-Aryan origin”. The search for a new environment began in earnest. He had the strong support of Albert Einstein⁶⁴ and his former supervisor Arnold Sommerfeld⁶⁵ who wrote on his behalf though he

found himself in the difficult position of having already been approached to give a reference for someone else too:

Ich will aber gleich noch eine andere Empfehlung hinzufügen, welche mit der ersten konkurriert. Mein alter Schüler und Freund L. Hopf schreibt mir, dass er hoffe, eine Stelle in Indien zu erhalten, nachdem er seine Professur in Aachen verloren hat. Er ist neben Karman und Prandtl der beste Fachmann in Hydrodynamik und Aerodynamik, aber auch auf allen anderen Gebieten der klassischen Physik kompetent, Er hat hübsche populäre Bücher über Relativitätstheorie und partielle Differential-Gleichungen der Physik geschrieben. Er ist ein hervorragender Lehrer, ist auch über Quantenmechanik gut orientiert und hat darüber Vorlesungen gehalten. Er ist auch ein besonders angenehmer Mensch und Kollege.

[I want to immediately add another recommendation which is in competition with the first. My pupil in former days and friend L. Hopf writes to me that he hopes to obtain a position in India after losing his professorship in Aachen. Apart from Karman and Prandtl he is the best specialist in Hydrodynamics and Aerodynamics but is competent also in all other areas of classical Physics. He has written nice popular books on the theory of relativity and partial differential equations in Physics. He is an outstanding teacher, well informed in quantum mechanics on which he has given lectures. Furthermore he is an especially nice person and colleague.]⁶⁶

Thanks to references like this, his standing and his many connections, Hopf should have had a comparatively easy quest for a position elsewhere. But none of the early openings worked out and so Hopf returned a detailed questionnaire in October 1934 to the Academic Assistance Council, hoping for help there and naming as his specific fields a wide range of areas: “Hydrodynamics, theory of aeroplanes, differential equations, modern theoretical physics (especially popular lectures)”.⁶⁷

In many ways he was comparatively well off as his income after his enforced retirement included his pension of RM 6000, plus interest of nearly RM 1000 (while his income from his salary in 1932/33 had been nearly RM 18,000 plus interest of nearly RM 2000). However, when he sent the information that would hopefully lead to a new career elsewhere to the Academic Assistance Council (that became the Society for the Protection of Science and Learning, in short SPSL) in October 1934, he had five children to look after, now aged 21 (Hans), 19 (Peter), 18 (Arnold), 16 (Dietrich) and the only daughter, Liselore, now 10 years old. Hans and Peter were already in England. Hopf’s main aim in the following years was to enable them all to study abroad while trying to find a position himself. While Hopf indicated that he was happy to go to any country “if healthy” and where his children could live and go to school or university, his answer to the question whether he was willing to accept a position

in industry and commerce was “no”, the same response he gave to the question whether he was willing for the SPSL to approach a religious community on his behalf.⁶⁸

Initially, a number of avenues seemed possible, ranging from National Advisory for Aeronautics, U.S.A. (where Hopf was among the founding members) or a fellowship from the Carnegie Corporation for potential academic positions⁶⁹ and Albert Einstein among others such as Peter Paul Ewald and Sydney Goldstein in Cambridge continued in his support for his former assistant and colleague. Ludwig Hopf was on the ‘List of Displaced German Scholars 1936’ published by the ‘Notgemeinschaft Deutscher Wissenschaftler im Ausland’ [Emergency Association of German Scientists Abroad].⁷⁰ Hopf’s search for a new position and a way out of Germany continued. With his latest publication *Materie und Strahlung: Korpuskel und Feld* [Matter and Radiation: Particle and Field]⁷¹ which could still appear in 1936 in Berlin (thanks to the support by Springer publishing house of its scientific Jewish authors and editors) in the series “Understandable Science” [“Verständliche Wissenschaft”] he reminded his former colleagues abroad of his existence and his desperate search for a refuge.⁷² He continued to work and maintain academic contacts and managed to a small extent still to connect to an outside world which was increasingly hard to reach. Some contacts still worked well. In Zurich, Hopf stayed with his younger cousin Heinz Hopf, also a mathematician, who had already achieved a considerable reputation in his field.⁷³

In a time of so many people in need, his case was seen by the SPSL as somewhat less urgent, as in contrast to many others he still received his – soon further reduced – pension.

In June 1938 one attempt by Albert Einstein was to improve Hopf’s chances to be a sought-after candidate in the USA by having his books on relativity and radiation appear. However, Quincy Howe of Simon and Schuster Publishers in New York declined to take them on, arguing that the difficulty was not so much with the books or the author “but with the market and the American public” and that the books were “a little too difficult in some sections and in others they cover material that has already been presented in popular form.”⁷⁴ A few months later there was a fear among his colleagues abroad that he and other dismissed academics would not even be allowed to leave the country anymore.⁷⁵

The situation became even more desperate after ‘Kristallnacht’ [‘Night of Broken Glass’] on 9/10 November 1938. When Jewish men were rounded up and imprisoned by the Nazis, Hopf’s son Arnold pretended to be his father and was taken to Buchenwald concentration camp. He was released three weeks later in December 1938 as he was able to obtain papers showing his impending emigration to Kenya.⁷⁶ Arnold Hopf was one of the 13,687 Jews imprisoned in the KZ Buchenwald between April and December 1938. Of these, 10,012 were

released like Hopf by the end of 1938 when able to produce emigration papers.⁷⁷ For Ludwig and Alice Hopf these three weeks were, despite all the hardship of recent years, the greatest burden of all.⁷⁸ The new persecutions galvanised further assistance activities and at long last, in early February 1939, the possibility of a research grant in Cambridge materialised, not least thanks to the efforts of Sydney Goldstein in Cambridge and Peter Paul Ewald, now in Belfast. Daughter Liselore (also called Mädi), now aged 14, received a crash course in English thanks to Otto Blumenthal⁷⁹ and in late March 1939 she, Ludwig and Alice Hopf left for England. Three weeks later they registered in Cambridge where they settled at 86 Lovell Road.⁸⁰

And then, after Hopf had almost given up all hope, an academic position materialised after all. He became the lucky “Refugee of distinction (chosen from the many now available)” selected following a decision by Junior Fellows and Professors of Trinity College Dublin to support such a person and bring them to lecture in Dublin.⁸¹ Together with his wife Alice, their daughter Liselore and his parents-in-law, he arrived in Ireland on 17 July 1939.

His main objective had been achieved – his sons were all abroad and he himself had finally been able to leave Germany and even to have a position in his field. The old connections still existed. A first greeting from the old life was a book sent by Arnold Sommerfeld to his former student. Hopf’s subsequent report in August to his old professor is accordingly very upbeat. He had just moved into a new home, had heard about the impending arrival of the creator of wave mechanics (a coded reference to Nobel Prize winning Erwin Schrödinger taking up a position in the planned Dublin Institute of Advanced Studies) and Dublin made a very good impression on him. Its inhabitants seemed friendly (though not always reliable). A fly in the ointment was the expenses: he estimated that everything cost 50% more than in Cambridge.⁸² His presence was a welcome addition in refugee circles and was helpful to newcomers. Contacts with fellow academics in exile such as serologist Hans Sachs⁸³ and from early October onwards Erwin Schrödinger were quickly established. His address at 65, Kenilworth Square seems to have become quickly a welcome place of refuge and invitation for young refugees from Germany. Hans Reiss, who had arrived in Dublin five weeks after Hopf, having just turned 17, remembers seeing two large paintings by Franz Marc⁸⁴ there that he did not appreciate at the time.⁸⁵ Dr John Hennig mentions in his diary several meetings with Hopf soon after his arrival in Ireland.⁸⁶

Following the outbreak of the war communication became more difficult and the situation of his sons in England became more precarious as potential enemy aliens. Both Hans and Peter were awaiting the tribunals in order to be able to continue their lives. Apart from that his time

was taken up with preparing his lectures in Trinity: “My lectures will begin in 4 weeks time; I have plotted a lot of them and hope to have enough self-confidence (or impudence) to go on.”⁸⁷ His circumstances were far from grand; he wrote to his cousin Heinz Hopf in November 1939 that his grant covered food but not really clothing. However, he was happy with the way his lectures were working out, even without the use of familiar manuscripts and professed astonishment about how far one gets with boldness in the use of a foreign language – in which he and Alice were behind their daughter.⁸⁸ Slowly his social circle extended to his work place as well but he started to feel a bit unwell. To Arnold in Keny he wrote:

We are rather well; I, to begin with, indeed am a little ill since a fortnight, sleep too much, cannot eat what I want and cannot walk; but I am on the way to improvement and then I hope also to work more as until now. At the present moment there is great business at the College, lectures, meetings and so on, but not so much social things. This week for the first time we are sometimes invited to tea.⁸⁹

A few weeks later, Hopf’s health deteriorated dramatically. A previously undiagnosed thyroid failure proved fatal. He died on 21 December in the evening. As Annemarie Schrödinger described in her letter to Sommerfeld⁹⁰ (asked to pass the terrible news on by Alice), Hans and Peter Hopf were not able to come over to Ireland from England before their father died, but did attend the funeral, a small gathering consisting mainly of colleagues and refugees.⁹¹ Alice Hopf informed their old friend Otto Blumenthal and asked him to notify Theodore von Kàrmàn and other friends. When Blumenthal did so it was clear how distraught he was over the death of his former friend and colleague who, as he wrote, was so indispensable to his family, had still such a lot to contribute professionally and was one of the most intelligent people Blumenthal had ever met.⁹² The shock about Hopf’s sudden death was felt deeply, but nowhere so much as within his family. In her letter to Theodore von Kàrmàn, Alice Hopf, Ludwig’s widow, wrote about her husband’s love for life despite all the hardship of the last years and that no one else could set so much kindness and wisdom against the turmoil of existence.⁹³

Let us finish with a visit to Mount Jerome. When one goes there today, one can find that not too far from Hopf’s grave is that of fellow refugee Hans Sachs who was among the small group of mourners at the funeral and was one of the two speakers to provide short appreciations, his in German, Erwin Schrödinger’s in English. It is not too difficult to conjure up the scene on that dark December day in 1939 when Schrödinger addressed the mourners:

Standing abashed at your early grave we hardly realise that the kindhearted and cheerful man who had made his appearance to this island not long ago and had immediately won the hearts of all who came to know him, - we are hardly able to realise that he has left us forever.

Ludwig Hopf's life may, I think, be called a happy one. His lodestar was truth. The finding of knowledge was what he strained all his nerves for. His remarkable gifts led him quickly from step to step, from success to success and made his name known all over the world to fellow-scientists. His fatherland duly honoured him. He was a friend of the great geniuses of his time, indeed he was one of them.

Likewise friendly were the stars that shone on the other side of Ludwig Hopf's life, the inner side, turned towards house and hearth. Five children sprang from his marriage with a beloved and devoted wife. They grew up to display such gifts of heart and mind as would enable them to make their way in the world and as are bound to be the joy and cheer of their parents.

Gloomy clouds shadowed the last year of his life. There were months of dire anxiety and when he and his wife were trembling for the fate of their sons whom they knew to be at the mercy of fierce hatred and brutal force. Eventually the family was – like ten thousands of others – driven away from their home, but they were spared the worst: they could take all their children safe and unhurt with them.

Unequalled friendliness and hospitality, met with abroad, rewarded them, like many others, for what they had lost. Indeed our gentle friend, whose loss we deplore, never complained his lot. A Bavarian by birth, attached to the cheerful Rhineland for many years, his gay and joyful spirit was unabatable. He soon began to love this country which had received him with such kindness, and to love a people whose mentality he felt to be akin to his own. He would have continued to call himself a happy man, had it pleased Providence not to take him away from us.

His loss is irretrievable to all of us, and more so to his next of kin. In bidding him his last farewell, we are determined to preserve his memory and to remember his friendship with gratitude.⁹⁴

Sadly, Ludwig Hopf is one of many whose lives were irretrievably altered and damaged by hatred and stupidity. He had extraordinary abilities and a passion for passing on and developing further the newest ideas in the sciences. Just like almost all of the German-speaking refugees who came to Ireland, he had started to feel at home and to feel enriched by the country that took him in (though fairly reluctantly), enriching in turn the cultural and social fabric in Ireland. And just like the other academic exiles in Ireland such as Schrödinger, Walter Heitler, Ernst Lewy, Hans Sachs and others, he would surely have made significant contributions to his new community.

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¹ See Frank McNally: An Irishman's Diary. In: *Irish Times*. 22 January 2014, as well as the earlier articles in the *Irish Times* on 17 April 2013, 10 January 2013 and 20 December 2012.

² See for example Abraham Pais: *Subtle is the Lord: The Science and the Life of Albert Einstein*. Oxford-New York: Oxford University Press 2005. Here: P. 485 and Carl Seelig: *Albert Einstein*. Zürich-Stuttgart-Wien: Europa 1954. Here: P. 125.

³ Michael Eckert: *Arnold Sommerfeld. Atomphysiker und Kulturbote 1868-1951*. Deutsches Museum Abhandlungen und Berichte, Volume 29. Göttingen: Wallstein 2013, and its English translation, *Arnold Sommerfeld - Science, Life and Turbulent Times 1868-1951*. Berlin: Springer 2013. Translated by Tom Artin. Several other of Eckert's publications are referred to later in this article. There is also a short chapter on Ludwig Hopf in Arnold Sommerfeld: *Wissenschaftlicher Briefwechsel*. Volume 1: 1892-1918. Ed. by Michael Eckert and Karl Märker. Berlin-Diepholz-München: Deutsches Museum, GNT-Verlag 2000. Here: Pp. 273-274.

⁴ See for example Max Pinl, Lux Furtmüller: Mathematicians under Hitler. In: *Yearbook of the Leo Baeck Institute*, 18/1973. Pp. 129-182; *Transcending Tradition: Jewish Mathematicians in German Speaking Academic Culture*. Ed. by Birgit Bergmann, Moritz Epple, and Ruti Ungar. Berlin-Heidelberg: Springer 2012.

⁵ Cf. Dietmar Müller-Arends with Ulrich Kalkmann: Ludwig Hopf 1884-1939. In: *Wissenschaft zwischen technischer u. gesellschaftlicher Herausforderung - Die RHTW Aachen 1970-1995*. Ed. by Klaus Habetha. Aachen: Einhard 1995. Pp. 208-215. Thanks to Conny Lutter, TU Aachen.

⁶ Günther Frei, Urs Stammbaum: Heinz Hopf (1894-1971). In *History of Topology*. Ed. by I.M. James. Amsterdam: Elsevier 1999. Pp. 991-1008. Here: 991.

⁷ Ibid. Stephan Hopf served at various times as 'Kommerzienrat', 'Magistratsrat' and 'Landrat'.

⁸ Cf. Gerhard Jochem: Geschichte der Hopfengroßhandlung S. Krakenberger, Nürnberg-Saaz. http://www.rijo.homepage.t-online.de/pdf/DE_NU_JU_krakenberger.pdf. Downloaded 26.3.2014.

⁹ Cf. Arnold Sommerfeld, Fritz Seewald: Ludwig Hopf zum Gedächtnis. In: *Jahrbuch der Rheinisch-Westfälischen Hochschule Aachen* 5 (1952/53). Pp. 24-26. Here: P. 24.

¹⁰ Cf. Michael Eckert: *Arnold Sommerfeld. Atomphysiker und Kulturbote 1868-1951*. Here: P. 9.

¹¹ See David C. Cassidy: *Beyond Uncertainty – Heisenberg, Quantum Physics, and the Bomb*. New York: Bellevue Literary Press 2009. Here: P. 84. Hermann Brück (1905-2000), who came to Dublin after the war as Director of Dunsink Observatory at the invitation of Eamon de Valera, had also been supervised by Sommerfeld and called him "by far the best university teacher I have ever met". Recollections of Student Years in Germany. In: *The Making of Physicists*. Ed. by Rajkumari Williamson. Bristol: Adam Hilger 1987. Pp. 71-73. Here: P. 72.

¹² Cf. Eckert: *Sommerfeld - Science, Life and Turbulent Times*. Chapter 14.6. The Nobel Prize Denied. Here: Pp. 431-432.

¹³ Cf. Sommerfeld, Seewald: Ludwig Hopf zum Gedächtnis. Here P. 24. Sommerfeld specifically mentions Hopf's acquaintance with philosopher Al Raschid Bey (Friedrich Arnd), husband of bestselling author Helene Böhlau who published his monograph *Das hohe Ziel der Erkenntnis* in 1912, a year after his death.

¹⁴ Peter Paul Ewald incidentally also became a refugee in Ireland though in the northern part, as lecturer and later professor in physics in Belfast. See also Michael Eckert: Peter Paul Ewald (1888-1985) im nationalsozialistischen Deutschland – Eine Studie über die Hintergründe einer Wissenschaftleremigration. In: *'Fremde' Wissenschaftler im Dritten Reich. Die Debye-Affäre im Kontext*. Ed. by Dieter Hoffmann, Mark Walker. Göttingen: Wallstein 2011. Pp. 265-289.

¹⁵ Sommerfeld, Seewald: Ludwig Hopf zum Gedächtnis. P. 24 (the same page also contains an obituary of Arnold Sommerfeld himself).

¹⁶ Interview of Peter Debye by T.S. Kuhn and G. Uhlenbeck on 3 May 1962. Niels Bohr Library & Archives, American Institute of Physics, http://www.aip.org/history/ohilist/4568_1.html. Downloaded 4.3.2014.

¹⁷ Ibid. Peter Debye also still remembered bringing Hopf a whole sack of sugar for his sugar solutions. Debye does not recall in that interview the exchange he had with Ludwig Hopf with regards to Hopf's exclusion from the celebrations of Sommerfeld's 70th birthday in 1938. Regarding Peter Debye and his role in German Physical Society under Hitler see Dietmar Hoffmann, Mark Walker: *'Fremde' Wissenschaftler im Dritten Reich. Die Debye-Affäre im Kontext*. Göttingen: Wallstein 2011. Specifically Stefan L. Wolff: Das Vorgehen von Debye bei dem Ausschluss der 'jüdischen' Mitglieder aus der DPG. In: Ibid. Pp. 110-134. Here: P. 117f.

¹⁸ Eckert: *Sommerfeld - Science, Life and Turbulent Times*. Here: P. 162.

¹⁹ Cf. Ibid. For more detail on Hopf's work in the context of hydrodynamic research see Michael Eckert, The troublesome birth of hydrodynamic stability theory: Sommerfeld and the turbulence problem. In: *European Physical Journal*. Volume 35/1 (2010). Pp. 29-51. Here 37.

²⁰ Eckert: *Sommerfeld - Science, Life and Turbulent Times*. Here: P. 162.

²¹ Sommerfeld to Munich Faculty 5 July 1909. See Arnold Sommerfeld: *Wissenschaftlicher Briefwechsel*. Volume 1. Here: P. 273.

²² Ludwig Hopf: *Hydrodynamische Untersuchungen: Turbulenz bei einem Flusse. Über Schiffswellen*. Inaugural Dissertation. Leipzig: J. A. Barth 1910 and Hopf: Turbulenzen bei einem Flusse. In: *Annalen der Physik*. Volume 32/4. Pp. 777-808.

²³ Cornelius Lanczos: *Albert Einstein – His Life and his Work*. Statutory Lecture Dublin Institute of Advanced Studies, 1956. National Library of Ireland. Here: P. 4.

²⁴ Cf. Banesh Hoffmann: *Albert Einstein – Creator and Rebel*. London: Hart-Davis, MacGibbon 1972. Here: P. 88.

²⁵ Ronald W. Clark: *Einstein – The Life and Times*. London: Hodder and Stoughton 1973. Here: P. 133.

²⁶ Einstein had first asked his Zurich student Hans Tanner to be his assistant in Prague though, due to the “erbärmliche Bezahlung” on offer, Tanner had to decline and Einstein arranged for him to have a better paid position in Basel. Seelig: *Albert Einstein*. Here: P. 124.

²⁷ Peter Debye, Interview conducted by T.S. Kuhn and G. Uhlenbeck, May 3, 1962, AHQP. http://www.aip.org/history/ohilist/4568_1.html. Downloaded 28.2.2014.

²⁸ Cf. Denis Brian: *Einstein: A Life*. New York: John Wiley & Sons 1996. Here: P. 75. See also Seelig: *Albert Einstein*. Here: P. 126.

²⁹ Eckert: *Sommerfeld - Science, Life and Turbulent Times*. Here: P. 174.

³⁰ Seelig: *Albert Einstein*. Here: P. 125. Incidentally, Carl Seelig's book on Einstein was given to Ludwig Hopf's widow Alice in 1959 by Frederick O'Connor, a former assistant at Dunsink Observatory in Dublin who lectured at Trinity College and had attended Ludwig Hopf's funeral, indicating that links to Dublin remained long after Alice had moved to England in October 1943. Thanks to Willie Walshe and the Hopf family in Kitala for lending me the book that had made its way to Kenya.

³¹ Ibid. Here: P. 152: “Sein heiteres Naturell tat Einstein wohl, und wenn sich der weltfreudige Bayer 1911 dennoch entschloß, eine Assistentenstelle in Aachen anzunehmen, so geschah es in der Meinung, es stehe einem Mann nicht an, sich jahrelang an die Rockschoße eines berühmteren Kollegen zu hängen. Seine Verbindung zu Einstein hat der aus Nürnberg stammende Dr. Ludwig Hopf, der in Aachen bald der beliebteste Dozent für angewandte Mathematik und Mechanik wurde, jedoch nie aufgegeben.” [His cheerful disposition was good for Einstein. The reason why the open-minded Bavarian decided to accept an assistant position in Aachen in 1911 was his belief that a man should not hang on the coattails of a famous colleague for years. Dr. Ludwig Hopf, a native of Nuremberg who soon became the most popular lecturer in applied mathematics and mechanics in Aachen, never gave up his link with Einstein.]

³² Sommerfeld, Seewald: Ludwig Hopf zum Gedächtnis. Here: P. 24. See Seelig: *Albert Einstein* for C.G. Jung's perspective on his meetings with Einstein and later repercussions. Here: Pp. 127-128.

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- ³³ Albert Einstein and Ludwig Hopf: Über einen Satz der Wahrscheinlichkeitsrechnung und seine Anwendung in der Strahlungstheorie. In: *Annalen der Physik* 33 (1910). Pp. 1096-1104. Also Einstein and Hopf: Statistische Untersuchung der Bewegung eines Resonators in einem Strahlungsfeld. In: *Annalen der Physik* 33 (1910). Pp. 1105-1115.
- ³⁴ Ludwig Hopf and Arnold Sommerfeld: Über komplexe Integraldarstellung der Zylinderfunktionen. In: *Archiv der Mathematik und Physik*, 3/18 (1911). Pp. 1-16.
- ³⁵ Clark: *Einstein*. Here: P. 142.
- ³⁶ Hopf to Einstein, 31 October 1911. Document 294. In *Collected Papers of Albert Einstein*. Vol. 5. The Swiss Years: Correspondence, 1902-1914. Princeton-Oxford: Princeton University Press 1995. Pp. 335-336. Here: P. 335. Special thanks to Michael Eckert, Forschungsinstitut Deutsches Museum, München, for this and all his support during my research stay in Munich and since.
- ³⁷ Ibid and Sommerfeld: *Wissenschaftlicher Briefwechsel*. Volume 1. Here: P. 274.
- ³⁸ August Wilhelm Quick: Hopf, Ludwig. In: *Neue Deutsche Biographie*. Berlin: Duncker & Humblot 1972. P. 608. [Online version] <http://www.deutsche-biographie.de/pnd127215972.html> . Downloaded 2.4.2014.
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- ⁴⁰ Cf. Volkmar Felsch: *Otto Blumenthals Tagebücher. Ein Aachener Mathematikprofessor erleidet die NS-Diktatur in Deutschland, den Niederlanden und Theresienstadt*. Ed. by Erhard Roy Wiehn. Konstanz: Hartung-Gorre 2011. Here: P. 496. For more information on Blumenthal see ibid and Volkmar Felsch: *Der Aachener Mathematikprofessor Otto Blumenthal*. Edited version of his lecture at the Volkshochschule Aachen, 1.10.2003 (29.1.2008) <http://www.math.rwth-aachen.de/~Blumenthal/Vortrag/index.html>. Downloaded 10.4.2014. See also Paul Butzer, Lutz Volkmann: Otto Blumenthal (1876–1944) in retrospect. In: *Journal of Approximation Theory*. Volume 138/1 (2006). Pp. 1-36.
- ⁴¹ See also Eckert: The troublesome birth of hydrodynamic stability theory. Pp. 38-39.
- ⁴² Ludwig Hopf: Der Verlauf kleiner Schwingungen auf einer Strömung reibender Flüssigkeit. In: *Annalen der Physik*. Volume 44 (1914). Pp. 1-60.
- ⁴³ Richard Fuchs, Ludwig Hopf: *Aerodynamik*. Handbuch der Flugzeugkunde. Volume 2. Berlin: R. C. Schmidt 1922.
- ⁴⁴ See Michael Eckert: *The Dawn of Fluid Dynamics: A Discipline Between Science and Technology*. Weinheim: Wiley 2006. Here: P. 120.
- ⁴⁵ Cf. Seelig. Here: P. 152. See also the testimony of Paul Butzer's parents: "Hopf was highly respected and admired by his students". See Paul Butzer, Lutz Volkmann: Otto Blumenthal (1876–1944) in retrospect. In: *Journal of Approximation Theory*. Volume 138/1 (2006). Pp. 1-36. Here: P. 5, fn. 15.

⁴⁶ See for example Abhandlungen über die hydrodynamische Theorie der Schmiermittelreibung. Ed. by Ludwig Hopf. Ostwald's Klassiker der exakten Wissenschaften Nr. 218. Leipzig: Akademische Verlagsgesellschaft 1927 and, together with August Gilles and von Kármán: Vorträge aus dem Gebiete der Aerodynamik und verwandter Gebiete. Berlin: Julius Springer 1930.

⁴⁷ Ludwig Hopf: *Die Relativitätstheorie*. Berlin: Springer 1931. Cf. Seelig: *Einstein*. Here: P. 152:

“Wahrscheinlich existiert keine populärwissenschaftliche Schrift, die klarer und anschaulicher über die ‘Relativitätstheorie’ orientiert, als sein 1931 erschienenes, so betitelt Bändchen” [Probably there is no other popular science publication that orientates the reader as clearly and vividly about the ‘theory of relativity’ than his small volume with this title published in 1931].

⁴⁸ Ludwig Hopf: *Einführung in die Differentialgleichungen der Physik*. Berlin: de Gruyter 1933.

⁴⁹ See Ulrich Kalkmann: *Die Technische Hochschule Aachen im Dritten Reich (1933-1945)*. Aachen: Verlag Mainz 2003. Here: P. 120.

⁵⁰ Ibid. Here: P. 130.

⁵¹ Otto Gessler to Ludwig Hopf, 18.5.1933, Hochschularchiv RWTH Aachen.

⁵² Reference Felix Wagenführ, 15.3.1933 Hochschularchiv RWTH Aachen.

⁵³ “Seine Vorlesungen über einige der Spezialgebiete der theoretischen Physik, die er über seine Lehrverpflichtungen hinaus in selbstloser Weise hielt, waren für fortgeschrittene Studierende von größtem Wert. Besonders rühmend muß noch hervorgehoben werden, in welcher geschickter und objektiver Weise er zwei Jahre lang dem Außeninstitut vorstand.” [His lectures on some of the special fields of theoretical physics, which he selflessly taught on top of his teaching obligations, were of the greatest value for advanced students. It also needs to be strongly emphasized that he headed the External Institute in an adroit and objective manner for two years].

⁵⁴ Hopf to Sommerfeld, 24.5.1933. See Sommerfeld: *Wissenschaftlicher Briefwechsel*. Volume 2. Here: P. 386.

⁵⁵ Ibid.

⁵⁶ Ibid. Here: P. 388. The question of Hopf's religious inclinations remains uncertain. Felsch states that the Hopfs were, like their friends the Blumenthals, Protestant and that Mali Blumenthal was Liselore's godmother (see Felsch: *Otto Blumenthals Tagebücher*. Here: P. 496). Hopf himself answered on the Society for the Protection of Science and Learning questionnaire that no religious affiliation was to be approached on his behalf. See below and Bodleian Library, SPSL files, Leopold (sic) Hopf. In this file is also an answer given by Hopf's son Hans regarding his father's religion – “konfessionslos” (not belonging to any religious community).

⁵⁷ Sommerfeld: *Wissenschaftlicher Briefwechsel*. Volume 2. Here: P. 386.

⁵⁸ Ibid. Hopf to Sommerfeld, 28.6.1933. Here: Pp. 389-390.

⁵⁹ See his letter of 24.6.1933 to Prof E. Wigner, Princeton: “Sehr verehrter Herr Kollege!

Professor Heisenberg, der einige Vorträge hier hielt, erzählte, dass Sie Namen von deutschen Professoren sammeln, die hier ihre Stellung durch die politischen Verhältnisse verlieren und eine Professur in Amerika anstreben. Ich erlaube mir daher die Bitte, auch mich in Ihre Liste aufzunehmen“ [Dear Colleague!

Professor Heisenberg, who held some lectures here, told me that you are collecting names of German professors who are losing their position here because of the political situation and are seeking a professorship in America. Allow me, therefore, to request that you also include me in your list]. Bodleian Library, Oxford, SPSL Hopf.

⁶⁰ Ludwig Hopf: *Mechanik des Flugzeugs*. Berlin: Springer 1934.

⁶¹ August Zinsser: Book Review Aerodynamic by Prof. Dr R. Fuchs, Prof. Dr. L. Hopf and Dr Fr. Seewald; Vol. I, Mechanics of the Airplane, by Prof. Dr. L. Hopf; Julius Springer, Berlin, 1934. In: *Journal of the Aeronautical Sciences*. Volume 2/1 (1935). P. 39.

⁶² Müller-Arends, Ulrich Kalkmann: Ludwig Hopf. Here: P. 212.

⁶³ Ibid. Here: P. 213: “Er ist selbst wohl nicht sehr ideenreich und kann sich z.B. mit Kármán in keiner Weise vergleichen, aber er versteht eine Menge Mathematik und Mechanik” [He himself is probably not very imaginative and cannot for example be compared with Kármán in any way, but he understands a lot of mathematics and mechanics].

⁶⁴ See several letters at the Albert Einstein Archives, Hebrew University of Jerusalem.

⁶⁵ An insight into Sommerfeld’s far-reaching connections and intense attempts to support his ‘non-Aryan’ colleagues and former students can be gained in the excellent publication of his academic correspondence: Arnold Sommerfeld: *Wissenschaftlicher Briefwechsel*. Volume 2: 1919-1951. Ed. by Michael Eckert und Karl Märker. Berlin, Diepholz, München: Deutsches Museum, GNT-Verlag 2004.

⁶⁶ Arnold Sommerfeld to Chandrasekhara Venkatu Raman (who received the Nobel Prize for Physics in 1930), 1.2.1934, Deutsches Museum, Munich, NL89, 003. Sommerfeld later points out, somewhat incorrectly, that while the other candidate was single Hopf was married with five children which is why he wanted to recommend Hopf especially (in fact, the other candidate, Rudolf Peierls, had married the Russian physicist Eugenia Kannegiser in 1931 and lived with her, their newborn first child and fellow Sommerfeld pupil Hans Bethe, in Manchester at the time. Peierls then went to Cambridge and eventually to Birmingham where he stayed as Professor for Mathematical Physics for the rest of his career). In the end, neither was appointed to the position in Bangalore but instead Max Born (1882-1970) though only for one year. Born had gone to Cambridge in 1933 where he had studied for a year in 1908/1909 and where he returned after his time in India. When Erwin Schrödinger turned down the position in Edinburgh Born was appointed there in autumn 1936. Later on he became a frequent visitor at the Dublin Institute of Advanced Studies.

⁶⁷ Questionnaire ‘General Information’ Ludwig Hopf, 29 October 1934, Bodleian Library, SPSL Hopf.

⁶⁸ Ibid.

⁶⁹ See Bodleian Library, SPSL Hopf. Here: Pp. 368, 371ff. – By chance, part of the correspondence was with Prof John Synge who later himself returned to Dublin.

⁷⁰ *Emigration – Deutsche Wissenschaftler nach 1933 Entlassung und Vertreibung, List of Displaced German Scholars 1936 Supplementary List of Displaced German Scholars 1937 The Emergency Committee in Aid of Displaced Foreign Scholars, Report 1941*. Ed. by Herbert A. Strauss et al. Berlin: Technische Universität Berlin 1987. Here: P. 52. Most of the senior academics who made it to Ireland for some time after 1933 can be found there: Alfred Bloch (p. 36), Walter Heitler (p. 97), Hans Motz (p. 99), Hans Sachs (p. 58) and Erwin Schrödinger (p. 101).

⁷¹ Ludwig Hopf: *Materie und Strahlung: Korpuskel und Feld*. Verständliche Wissenschaft, Volume 30. Berlin: Springer 1936.

⁷² See for example his correspondence with James Franck, 25.11.1936 and 8.1.1937, University of Chicago, James Franck papers. Hopf also seems to have sent it to Sigmund Freud as indicated by a postcard from Freud

to Hopf, dated 30.11.1936: “Ergebenen Dank! Aber ob ich’s verstehen werde? Ihr Freud”. Arden Family Holdings, Beverly Hills.

⁷³ See also Frei, Stammbaum: Heinz Hopf. Here: P. 1002. Following his PhD in 1925 at the University of Berlin Heinz Hopf (1894-1971) worked and continued his studies in Göttingen. In 1928/29 he went to Princeton University on a Rockefeller fellowship where he was offered a position in December 1929. However, he turned it down and instead accepted a chair in Zurich, in 1930, succeeding Hermann Weyl, incidentally a good friend of Erwin Schrödinger and especially of Annie Schrödinger.

⁷⁴ Quincy Howe to Albert Einstein, 6 June 1938, Einstein Archives, Hebrew University, Jerusalem 13/338.

⁷⁵ See letter from James Franck, former Professor for Physics in Göttingen and Nobel Prize winner in 1925, to Gábor Szegő, 16 October 1938: “The Germans – as far as I have heard – no longer let out any of the dismissed professors. These are obviously too inferior to be of any service for the Germans, but too good to let other countries have them. So I am afraid the case of our colleague sorts itself out.” Quoted from Reinhard Siegmund-Schultze: *Mathematicians fleeing from Nazi Germany – individual fates and global impact*. Princeton-Oxford: Princeton University Press 2009. Here: P. 90.

⁷⁶ Cf. Dietmar Müller-Arends with Ulrich Kalkmann: Ludwig Hopf. In: *Wissenschaft zwischen technischer u. gesellschaftlicher Herausforderung - Die RHTW Aachen 1970-1995*. Ed. by Klaus Habetha. Aachen: Einhard 1995. Pp. 208-215.

⁷⁷ Cf. Harry Stein: Buchenwald – Stammlager. In: *Der Ort des Terrors – Geschichte der nationalsozialistischen Konzentrationslager*, Vol 3 Sachsenhausen Buchenwald. Ed. by Wolfgang Benz and Barbara Distel. München: Beck 2006. Pp. 301-356. Here: Pp. 314-315.

⁷⁸ Alice Hopf to Kàrmàn, 19.5.1940: “3 Wochen Konzentrationslager Buchenwald, die schwerste Belastung, die mein Mann und ich in den letzten Jahren tragen mussten” [3 weeks concentration camp Buchenwald, the hardest burden my husband and I had to carry in the last years]. California Institute of Technology, Caltech Archives, T. von Kàrmàn Papers 13.31. Special thanks to Loma Karklins.

⁷⁹ See Felsch: *Otto Blumenthals Tagebücher*. Especially Pp. 88-90.

⁸⁰ Cf. Military Archives of Ireland, G2/049 Ludwig Hopf.

⁸¹ Trinity College Dublin Archive, Mun/Sec/248/ref/2. The background to this position and the negotiations that took place in its context are explored further in the forthcoming monograph on the German-speaking exiles in Ireland by Horst Dickel and Gisela Holfter.

⁸² Hopf to Sommerfeld, 17 August 1939, Deutsche Museum München Archive (NL 89, 025, Mappe Atombau): “Welche Freude haben Sie mir durch Übersendung Ihres Buches gemacht! Mehr wie sonst, es war so ein erster Gruss aus dem alten Lebensbereich. Und ich hoffe, auch das neue Leben wird mich oft zu dem Werke führen; denn gerade gestern hatte ich einen Brief, der mir den Schöpfer der Wellenmechanik für anfangs November ankündigt, und ich hoffe auf manches tiefer gehende Gespräch. Noch hat die rechte Arbeit nicht begonnen, denn erst seit ein paar Tagen sitzen wir in unserem neuen Heim, und es ist noch unvollkommen. Es wird aber sehr schön, eigentlich viel schöner, als ich erwartet hatte; so sehen wir dem neuen Leben recht vertrauensvoll entgegen. Nur ein Problem steht kaum lösbar vor uns, (das bisher immer das leichteste war) das finanzielle; wir haben zu wenig Einkommen. Dublin ist unglaublich teuer; sicher kostet alles 50% mehr als in Cambridge. Sonst

ist aber Dublin eine wunderschöne Stadt, schön gebaut, schön gelegen, lebensvoll und von freundlichen (wenn auch nicht immer zuverlässigen) Leuten bewohnt. Meine Frau ist leider sehr überbelastet, da Hilfe im Haushalt bei unserem Einkommen kaum denkbar ist. Zum Glück geht es den Kindern ordentlich [...].” [What joy you have given me by sending your book ! More than usual, it was a first greeting from the old area of life. And I hope, the new life will often lead me to more study. Just yesterday I had a letter announcing the creator of wave mechanics is coming at the beginning of November and I hope for some more in-depth conversation. The real work has not yet begun, we have been in our new home only for the last few days and it is still not ready. However, it will be very nice, actually much nicer than I had expected; so we look forward quite confidently to our new life. Only one problem before us is hardly solvable (up to now it has always been the easiest) the financial problem; we have too little income. Dublin is incredibly expensive; everything costs at least 50% more than in Cambridge. Otherwise, however, Dublin is a beautiful city, beautifully built, beautifully situated, full of life and inhabited by friendly (though not always reliable) people. My wife is unfortunately very overloaded as on our income a domestic servant is hardly conceivable. Luckily the children are doing fine]. Thanks to Michael Eckert.

⁸³ Cf. Horst Dickel: Hans Sachs. In: *German-speaking Exiles in Ireland 1933-1945*. Ed. by Gisela Holfter. Amsterdam/New York: Rodopi 2006 (German Monitor 63). Pp. 183-213; John Cooke: Hans and Charlotte Sachs. In: *Ibid.* Pp. 215-248.

⁸⁴ Franz Marc (1880-1916) was a key figure of German Expressionism and co-founder of the *Blaue Reiter* group. He died at the battle of Verdun. His paintings achieved record prices of several millions at auctions in the late 1990s.

⁸⁵ Hans Reiss: *Erinnerungen aus 85 Jahren*. Regensburg: Petrarca 2009. Here: P. 111.

⁸⁶ John Hennig: Tagebuch aus der Exilzeit in Irland 1939-46. Deutsches Exilarchiv der Deutschen Nationalbibliothek Frankfurt, EB 91/135-C.02.0003.

⁸⁷ Ludwig Hopf to Otto and Mali Blumenthal, 24.9.1939. Blumenthal family papers. Thanks to Volkmar Felsch, Aachen.

⁸⁸ Ludwig Hopf to Heinz Hopf, 18.11.1939. ETH-Bibliothek Zürich, Hochschularchiv, Hs 621: 725-726. With special thanks to Monika Bussmann.

⁸⁹ Ludwig Hopf to Arnold Hopf, 16.11.39. Thanks to Willie Walshe and the Hopf family in Kenya.

⁹⁰ Annemarie Schrödinger to Arnold Sommerfeld, 26.12.1939. Archive Deutsches Museum München (1977-28/A,315).

“Lieber Herr Sommerfeld, an und für sich war wenig Anlass, Weihnachten zu feiern, um so weniger, als ich am 20. abends ein paar Zeilen von Frau Hopf bekam, dass ihr Mann sehr sehr krank ist. Wir fuhren sofort hinüber und hörten zu unserem Entsetzen, dass der Arzt jede Hoffnung aufgab. Am 21. um 9 Uhr abends starb der liebe gute Ludwig Hopf. Heute haben wir ihn hier zu Grabe getragen und es war wirklich erschütternd. Die alten Eltern von Frau Hopf waren den Kindern in die Fremde gefolgt und mussten nun so plötzlich ihren jungen Schwiegersohn verlieren. Wir sind alle zu tiefst aufgewühlt durch das grausame Schicksal, welches das Leben eines ungemein gütigen Menschen dahinraffend, der ganzen Familie zu Teil wurde. Die zwei ältesten Söhne kamen am 22. aus England herüber und sind der armen Mutter und dem viel jüngeren Schwesterchen eine grosse Stütze.” [Dear Mr. Sommerfeld, In and of itself there was little reason to celebrate Christmas, even less

so as I received on the evening of the 20th a few lines by Mrs. Hopf that her husband is very, very sick. We drove over immediately and heard to our horror that the doctor gave up all hope. On 21 December by 9 clock in the evening our dear good Ludwig Hopf died. Today we have carried him to his grave here and it was really upsetting. The elderly parents of Mrs. Hopf had followed the children into a foreign land and have now suddenly lost their young son-in-law. We are all profoundly troubled by the cruel fate which affected the whole family by snatching away the life of an uncommonly good man. The two oldest sons came over from England on 22 December and are a great help to their poor mother and their much younger sister].

⁹¹ The funeral was reported upon in the *Irish Times* on 27.12.1939, p. 6:

FUNERALS

Dr. Ludwig Hopf died at his home in Dublin on December 21 after a short illness. He was born in Bavaria fifty-five years ago and was a brilliant student of Sommerfeld at Munich. He was for a long time assistant to Einstein at Prague and became later Professor of Applied Mathematics at Aachen. He was a well-known authority on aerodynamics, more especially the mathematical theory of flight. Professor Hopf found it necessary to leave Germany after November of last year, and since July he has been on the staff of Trinity College, Dublin, where he was able to carry on his important researches. His death is a great loss to the scientific world.

The funeral took place at Mount Jerome Cemetery on yesterday morning, conducted by the Rev. W.C.G. Proctor, B.D., and a German and an Austrian colleague gave short appreciations at the grave side of his life and work. He was a friend of the greatest geniuses of his time – indeed, he was one of them.

The chief mourners were: Frau Hopf (widow), Messrs Hans Hopf and Peter Hopf (sons), Miss Liselore Hopf (daughter), Geheimrat and Frau Dr. Goldschmidt (parents-in-law).

The attendance included: Professor E. Alton, S.F., T.D.C. (Registrar, Trinity College, Dublin); Professor K. C. Bailey, F., T.C.D.; Mr. N. O. Dobbs, Dr. Hennig, Mr. J. M. Henry, F., T.C.D.; Mr. T. Jackson, Professor A. J. McConnell, F., T.C.D.; Mr. F. J. O'Connor M.A.; Mr. Reiss, Professor C. H. Rowe, F., T.C.D.; Professor and Mrs. Hans Sachs, Professor and Mrs. E. Schroedinger, and Mr. E. L. Stringer

⁹² Blumenthal to Kármán, 10.1.1940. See Felsch: *Otto Blumenthals Tagebücher*. Here: P. 498. Blumenthal was at that stage in Delft, having remained in Aachen until July 1939 before at last finding temporary refuge in the Netherlands. However in April 1943 they were transported to the concentration camp at Vught, then Westerbork where Mali Blumenthal died after a few weeks due to her treatment in the concentration camps. Otto Blumenthal died in the concentration camp in Theresienstadt in 1944.

⁹³ Alice Hopf to von Kármán, 19.5.1940. California Institute of Technology, Caltech Archives, T. von Kármán Papers 13.31.

Similarly, she wrote to her son Arnold at the time: “But I must say to you, as I said to your brothers: don’t think that I am fully unhappy; I can never be. I was father’s wife; I will always be; and I feel this was such a great happiness, that something always will remain in my life, something that is beyond all grief and all the loneliness. I never can lose this. I know that I was happier than most people, and I was that for 27 years, even in spite of Hitler who spoiled our last years, and without him – I am sure – father would still live. But I feel he could not spoil father’s life in the most secret and most noble part of his soul; there was too much kindness in him, too much detachment of mind”. Thanks to Willie Walshe and the Hopf family in Kenya. This article is dedicated to them and any other descendants of Ludwig and Alice Hopf.

⁹⁴ Script of Erwin's Schrödinger's eulogy at Ludwig Hopf's grave, 26 December 1939. Thanks to Volkmar Felsch for the copy from the Blumenthal family papers.

⁹⁵ Photograph courtesy Deutsches Museum München Archive.